NREL's Building Energy Technology and Solar Buildings Programs

Developing energy efficiency and renewable energy technologies for buildings

The U.S. spends $200 billion annually to heat, cool, light and operate its 95 million homes and 4.5 million commercial buildings. That accounts for more than 60 percent of the electricity consumed in the U.S. The nation could reduce its energy use by 30 to 70 percent by simply incorporating advanced energy efficiency and renewable energy technologies into its buildings. The goal of NREL's Building Energy Technology and Solar Buildings Programs is to develop those technologies to help the nation achieve these savings.

NREL's Role

NREL is the country's leading laboratory for research and testing of passive solar, active solar and system engineering for buildings. Researchers evaluate existing technologies and develop new cost-effective and environmentally-friendly technologies that improve energy efficiency and increase the use of renewable energy in buildings. The Center for Buildings and Thermal Systems conducts advanced building technology research with support from the U.S. Department of Energy.

Major Research Areas

Solar Heating—NREL researchers help industry partners develop advanced, low-cost solar hot water heaters; help the Solar Rating and Certification Commission develop performance certification procedures for active solar domestic water systems; and evaluate the reliability of solar hot water systems. Researchers also work on various applications of NREL's award-winning transpired solar collector.

Electrochromic Window Testing—Researchers perform durability testing of electrochromic ("smart") windows. Electrochromic windows save energy by controlling heat gains and losses. An electrochromic film is applied to window surfaces, and computerized room sensors trigger changes in the film's opacity (its ability to block light) to reduce or increase solar gain.

Building America Program—Under this program, teams encompassing all segments of the housing industry (designers, builders, developers, financial institutions, material suppliers and equipment manufacturers) are created to develop a systems engineering approach to home-building. Instead of making independent decisions, decisions are made with consideration for the entire design, manufacturing and construction process, resulting in more efficient, affordable and higher quality housing. NREL provides industry teams with system engineering support and performs field tests of advanced building design and analysis tools.

Advanced Cooling and Dehumidification—Researchers evaluate and analyze advanced desiccant cooling systems and components, and test prototype systems. Desiccant cooling systems remove moisture from the air without the use of ozone-depleting compounds and improve energy efficiency, indoor air quality and occupant comfort.

Passive Solar—NREL collaborates with architects, engineers, and building owners to design, construct and field monitor buildings that use 50 to 75 percent less energy than current code compliant buildings. NREL acts as an energy design consultant for these projects using computerized thermal simulation techniques to optimize the building for heating, cooling, and lighting throughout all phases of the design process.

Design and Analysis Tools—NREL develops building energy design guidelines, simulation tools and evaluation tools. These include: Energy-10, a software design tool that lets architects and engineers easily incorporate passive solar technologies into small commercial buildings; SERIRES, a simulation tool to assist in the design of passive solar residential buildings; MHEA, a computerized auditing tool to help the National Low Income Weatherization Program improve the cost-effectiveness of mobile home retrofits; STEM, a short term monitoring method for verifying building performance in the field; and BESTEST, a building energy software test method that is being adopted as the industry standard.

Home Energy Rating Systems—NREL is helping the Home Energy Rating System Council develop a certification program to evaluate how well home energy rating systems predict heating, cooling and equipment loads for major U.S. climatic zones and building types.

Building-Integrated Photovoltaics—Researchers identify and evaluate promising markets for photovoltaics in buildings, and develop methods for integrating photovoltaic systems into buildings. Photovoltaics, commonly called solar cells, directly convert sunlight into electricity.

Recent Accomplishments

Transpired Solar Collector—NREL's transpired solar collector is a solar air heating system that significantly cuts heating costs in industrial and commercial buildings by preheating outside air by as much as 30°C (54°F). The system received *R&D 100* and *Popular Science* "Best of What's New" awards in 1994, and is commercially manufactured by an industry partner.

Vacuum Insulation—NREL's innovative catalytic converter dramatically reduces vehicle emissions by wrapping the converter in compact vacuum insulation—a highly effective form of insulation developed by the Buildings Program—to keep it operating at efficient temperatures for up to 24 hours after the engine is shut off. The catalytic converter won an *R&D 100* award in 1996 and is being commercially developed by an industry partner.

Energy-10—NREL researchers developed Energy-10, a user-friendly computer software program designed to make it easier for architects, engineers and builders to integrate solar technologies and energy efficiency features into the design of small commercial buildings. The Energy-10 software won the *Architecture Magazine* Progressive Architecture R&D Award for 1997.

Thermal Test Facility—NREL's new Thermal Test Facility (TTF) was designed with integrated energy efficiency technologies—including high-efficiency lighting, space conditioning (heating, ventilation and air conditioning), water heating and daylighting design—that reduce energy use by 60 percent. The 10,000 square-foot TTF houses NREL's active solar, passive solar and ventilation test facilities.

Industry Collaboration

Over half of the Building Program's funding is invested in cost-shared industry partnerships to leverage federal and industry research dollars and accelerate the development and adoption of advanced technologies. The NREL/industry collaboration is essential. To achieve optimal effectiveness, advanced building technologies need to be part of an integrated design—meaning the various segments of the building industry must come together as a team. NREL helps facilitate this team approach through programs such as Building America.

Benefits

Advanced building technologies reduce energy use; improve indoor and outdoor environmental quality; lower our fuel bills; improve living and work environments; improve economic competitiveness by reducing energy imports and exporting new technology; and increase international leadership in building technologies.

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